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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In Re Application of:

Applicants:	:	Constantine J. Tsikos and C. Harry Knowles
Serial No.	:	10/068,803
Filing Date	:	February 6, 2002
Title of Invention	:	BIOPTICAL PRODUCT AND PRODUCE IDENTIFICATION SYSTEMS EMPLOYING PLANAR LASER ILLUMINATION AND IMAGING (PLIIM) BASED SUBSYSTEMS
Examiner	:	n/a
Group Art Unit	:	2876
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Honorable Commissioner of Patents
and Trademarks
Washington, DC 20231

INFORMATION DISCLOSURE STATEMENT
UNDER 37 C.F.R. 1.97

Sir:

In order to fulfill Applicants' continuing obligation of candor and good faith as set forth in 37 C.F.R. 1.56, Applicants submit herewith an Information Disclosure Statement prepared in accordance with 37 C.F.R Sections 1.97, 1.98 and 1.99.

The disclosures enclosed herewith are as follows:

U.S. PUBLICATIONS

NUMBER	FILING DATE	TITLE
6,369,401	September 10, 1999	THREE-DIMENSIONAL OPTICAL VOLUME MEASUREMENT FOR OBJECTS TO BE CATEGORIZED
6,310,964	October 28, 1999	PRODUCE SIZE RECOGNITION SYSTEM
6,223,988 B1	October 14, 1997	HAND-HELD BAR CODE READER WITH LASER SCANNING AND 2D IMAGE CAPTURE
6,005,959	July 21, 1997	PRODUCE SIZE RECOGNITION SYSTEM
Re: 36,528	March 24, 1995	OPTICAL SCANNING HEAD
5,988,506	June 16, 1996	SYSTEM AND METHOD FOR READING AND DECODING TWO DIMENSIONAL

		CODES OF HIGH DENSITY
5,986,745	March 24, 1997	CO-PLANAR ELECTOMAGNETIC PROFILE SCANNER
5,859,418	January 25, 1996	CCD-BASED BAR CODE SCANNER WITH OPTICAL FUNNEL
5,828,050	October 31, 1997	LIGHT EMITTING LASER DIODE SCANNER
5,825,803	December 14, 1995	MULTIPLE EMITTER LASER DIODE ASSEMBLY WITH GRADED-INDEX FIBER MICROLENS
5,786,582	December 8, 1995	OPTICAL SCANNER FOR READING AND DECODING ONE- AND TWO DIMENSIONAL SYMBOLOGIES AT VARIABLE DEPTHS OF FIELD
5,717,221	October 11, 1996	MULTIPLE LASER INDICIA READER OPTIONALLY UTILIZING A CHARGE COUPLED DEVICE (CCD) DETECTOR AND OPERATING METHOD THEREFOR
5,710,417	June 2, 1995	BAR CODE READER FOR READING BOTH ONE DIMENSIONAL AND TWO DIMENSIONAL SYMBOLOGIES WITH PROGRAMMABLE RESOLUTION
5,649,070	February 17, 1995	LEARNING SYSTEM WITH PROTOTYPE REPLACEMENT
5,621,203	June 30, 1994	METHOD AND APPARATUS FOR READING TWO-DIMENSIONAL BAR CODE SYMBOLS WITH AN ELONGATED LASER LINE
5,615,003	November 29, 1994	ELECTROMAGNETIC PROFILE SCANNER
5,546,475	April 29, 1994	PRODUCE RECOGNITION SYSTEM
5,545,886	July 29, 1993	BARCODE SCANNER USING AN ARRAY OF LIGHT EMITTING ELEMENTS WHICH ARE SELECTIVELY ACTIVATED
5,532,467	July 2, 1996	OPTICAL SCANNING HEAD

5,378,883	July 19, 1991	OMNIDIRECTIONAL WIDE-RANGE HAND HELD BAR CODE READER
5,319,185	July 24, 1992	SMALL-SIZE HAND-SUPPORTED BAR CODE READER
5,319,181	March 16, 1992	METHOD AND APPARATUS FOR DECODING TWO-DIMENSIONAL BAR CODE USING CCD/CMD CAMERA
5,291,009	February 27, 1992	OPTICAL SCANNING HEAD
5,258,605	April 6, 1992	SCAN GENERATORS FOR BAR CODE READER USING LINEAR ARRAY OF LASERS
5,212,390	May 4, 1992	LEAD INSPECTION METHOD USING A PLANE OF LIGHT FOR PRODUCING REFLECTED LEAD IMAGES
5,192,856	November 19, 1990	AUTO FOCUSING BAR CODE READER
5,136,145	August 28, 1990	SYMBOL READER
4,979,815	February 17, 1989	LASER RANGE IMAGING SYSTEM BASED ON PROJECTIVE GEOMETRY
4,900,907	March 18, 1987	OPTICAL INFORMATION READING APPARATUS
4,826,299	January 30, 1987	LINEAR DEIVERGING LENS
4,743,773	August 21, 1985	BAR CODE SCANNER WITH DIFFUSION FILTER AND PLURAL LINEAR LIGHT SOURCE ARRAYS
4,741,621	August 18, 1986	GEOMETRIC SURFACE INSPECTION SYSTEM WITH DUAL OVERLAP LIGHT STRIPE GENERATOR
4,687,325	March 28, 1985	THREE-DIMENSIONAL RANGE CAMERA

FOREIGN PUBLICATIONS

NUMBER	PUBLICATION DATE	TITLE
WO 01/71419 A2	September 27, 2001	LARGE DEPTH OF FIELD LINE SCAN CAMERA
WO 01/72028 A1	September 27, 2001	COPLANAR CAMERA SCANNING SYSTEM
60/190,273	May 29, 2001	COPLANAR CAMERA
WO 99/64980	December 16, 1999	IMAGING ENGINE AND METHOD FOR CODE READERS
WO 99/21252	April 29, 1999	FILAMENTED MULTI-WAVELENGTH VERTICAL-CAVITY SURFACE EMITTING LASER

TECHNICAL PUBLICATIONS

Web-based publication entitled "AV3700 Coplanar Illumination Option" by Accu-Sort Systems, Inc., www.accusort.com/products/coplanar.html, 1 page.

Web-based Product Brochure on Model 120 LIVAAR Short Wave IR Gated Camera Specification, by Intevac Corporation, Santa Clara CA, September 2001, pages 1-2.

Web-based presentation entitled "NEW LIVAR IMAGERY" by Intevac Corporation, Santa Clara CA, http://www.intevac.com/livar_imagery/livar_imagery.html. 2001, pages 1-9.

Web-based brochure for Intevac Photonics Division Products- Laser Illuminated Viewing and Ranging (LIVAR) System, Intevac, Inc., http://www.intevac.com/photonics/products.html, 2001, pages 1-5.

Web-based brochure entitled "High-Speed, Repetitively Pulsed Ruby Laser Light Source" by Physical Sciences Inc., http://www.psicvorp.com/html/prod/lasillum.htm, 2001, pages 1-4.

Web-based brochure entitled "Collimated Laser Diode Arrays" by INO, Inc., http://www.ino.qe.ca/en/syst_et_compo/clda.asp, 2001, pages 1-2.

Product Brochure for the Lasiris™ SNF Laser by StockerYale, Salem NH, 2001, pages 1-4.

Product brochure for DALSA IT-PA Image Sensors, by Dalsa, Inc., 2001pages 1-14.

Product Specification for "KAF-4202 SERIES Full-Frame CCD Image Sensor Performance

Specification" by Eastman Kodak Company, Rochester NY, June 29, 2000, pages 1-15.

User Manual for the Piranha CT-P4, CL-P4 High Speed Line Scan Camera by Dalsa, Inc., 2000, pages 1-30.

Product brochure for Sony ICX085AL 2/3-inch Progressive Scan CCD Image Sensor with Square Pixel for B/W Cameras, by Sony Corporation, 2000, pages 1-20.

Product brochure for "ML1XX6 Series for Optical Information Systems" by Mitsubishi Electric, December 1999, pages 1-4.

Web-based publication entitled "3-D Sensing" by Papadoupoulos, http://perso.club-internet.fr/dpo/numeerisation 3d, 1995, pages 1-12.

Scientific publication entitled "Laser triangulation: fundamental uncertainty in distance measurement" by Dorsch et al., Applied Optics, Vol. 33(7), March 1994, pages 442-450.

Scientific publication entitled "The Use of Diode Laser Collimators for Targeting 3-D Objects" by Clarke et al., Dept. Engineering/City Univ./London, 1994, pages 47-54.

Web-based research publication entitled "Green Machine" by Bruce Schechter, IBM Research, http://www.research.obm.com/resources/magazine/1999/number_3/machine399.html, 1999, pages 1-4.

Web-based research publication of Projects and Research Topics by Gabriel Taubin, IBM T.J. Watson Research Center, http://www.research.ibm.com/people/t/taubin/research.html#computer-vision-apps, 1978-1999, pages 1-19.

INTERNATIONAL SEARCH REPORTS

App. No.	Filing Date
PCT/US01/44011	August 6, 2002

STATEMENT OF PERTINENCE

U.S. Patent No. 6,369,401 to Lee discloses a three-dimensional measurement system and method for objects, such as oysters, which projects one or more laser lines onto a surface on which the object is currently located. The laser lines are picked up as parallel lines by a camera where no object is located on the surface. When an object is located on the surface, the camera obtains an image that includes lines displaced from the parallel lines as a result of the lines impinging on portions of the object that have a particular height associated therewith. The displacement data allows a processor to determine the height of the object at various positions of the object to be obtained. Volume can be obtained using a binary image of the object to calculate area from the height data. The object can then be classified according to its volume.

U.S. Patent No. 6,310,964 to Mohan et al. discloses a system and apparatus which uses image processing to recognize object size within a scene. The system includes novel image processing apparatus and methods to segment one or more object images from a background image of the scene. A processed image (that can be used to characterize size features) of the object(s) is then compared to stored reference images. The object size is recognized when a match occurs. The system can recognize object sizes independent of the number of objects present and the objects may be touching each other and overlapping. The system can be trained to recognize object sizes that it was not originally programmed to recognize.

U.S. Patent No. 6,223,988 B1 to Batterman et al. discloses a hand-held bar code reader which includes a laser scanning module and a two dimensional image sensor and processor for reading a bar code. The laser scanner assists the 2D image processing by providing information on location, type, range, reflectivity, and presence of bar code for 2D reading. Additionally, the 2D image reading operation is improved by using the laser scan as a spotter beam for aiming.

U.S. Patent No. 6,005,959 to Mohan et al. discloses a system and apparatus which uses image processing to recognize object size within a scene. The system includes novel image processing apparatus and methods to segment one or more object images from a background image of the scene. A processed image (that can be used to characterize size features) of the object(s) is then compared to stored reference images. The object size is recognized when a match occurs. The system can recognize object sizes independent of the number of objects present and the objects may be touching each other and overlapping. The system can be trained to recognize object sizes that it was not originally programmed to recognize.

U.S. Patent No. RE. 36,528 to Roustaei discloses the design for a bar code scanner using the Light Emitting Diode (LED), Optical Scanner assembly and Charge-Coupled Devices (CCD) capable of reading the barcode symbols at the variable distance. An optical passive elements for increasing the depth of field and a method of fabricating the scanning head by mass-production techniques are also disclosed.

U.S. Patent No. 5,988,506 to Schaham et al. discloses a system for reading two dimensional codes as well as regular bar codes. A laser scanner generates a narrow horizontal beam which scans a code by means of a scanning mirror in the vertical direction. This mirror receives the reflected beam and passes it on to the lens array to yield high quality imaging characteristics all across a large field of view angle. The lens array and an auto focusing system produce images of the scanning lines in the sensor plane - a CCD linear array. In the sensor's plane, sub aperture diaphragms generate partially overlapping fields of view from each of the elements of the lens array. The system electronics converts the CCD linear array electrical signals into digital data. A module synthesizes in real-time the partially overlapping line sections of the image signal into an integrated continuous line signal and stores them consecutively in the image memory. A system processor operates an autofocus, as well as code classification and decoding algorithms.

U.S. Patent No. 5,986,745 to Hermary et al. discloses a co-planar system for determining the shape and dimensions of a surface of an object which includes a projector for projecting a spatially coded pattern of radiation, e.g., light, in a selected plane onto the object. The system also includes a receiving device capable of imaging the reflected pattern in the selected plane, and a discriminator for determining which portion of the reflected pattern corresponds to which portion

of the projected pattern. By this means, a received signal representing less than the complete reflection from the projected pattern can be correlated with a discrete portion of the scanned object. The object is moved relative to the selected plane and the procedure repeated to obtain enough reliable data to generate a reasonably reliable surface profile. The resulting set of received signals and correlations are used to calculate the shape and dimensions of the object.

U.S. Patent No. 5,859,418 to Li et al. discloses an optical funnel which evenly distributes light from an array of LEDs to a bar code. A support member with a central aperture holds the LEDs. A shroud with an angled reflective interior surface spreads the light from the LEDs to the bar code. The funnel also optically isolates the LEDs from the photodetector in the scanner.

U.S. Patent No. 5,828,050 to Barkan et al. discloses a portable scanning head which emits and receives light from a light-emitting diode to read symbols, such as bar-code symbols. The optics within the scanner are operative for focusing a light beam and the view of a light sensor in different planes exteriorly of a scanner housing. Imaging means are provided in the unit for imaging a viewing window. The viewing window has an area smaller than that of the scan spot. The system can employ an LED as a light source and tolerate the relatively large-sized (on the order of millimeters) scan spot without sacrificing reading performance since the photodiode "sees" only that portion of the scan spot visible through the viewing window.

U.S. Patent No. 5,825,803 to Labranche et al. discloses a multiple emitters laser diode assembly which comprises a laser diode bar for emitting a laser beam. Th laser diode bar comprises a plurality of emitters aligned with respect to each other in a same plane of emission. A graded-index elongated fiber microlens is transversely set at a given distance in front of the laser diode bar for controlling the divergence of the beam. The microlens has an axis of symmetry substantially intersecting the optical axis of each emitter. A mount is provided for positioning the microlens with respect to the laser diode bar. Alternatively, the assembly may comprise a laser diode array for emitting the beam. The laser diode array comprises a plurality of substantially parallel rows of emitters with a substantially regular period between them. An array of graded-index elongated fiber microlenses is positioned substantially parallel to the rows. Each microlens corresponds to one of the rows for collimating the beam generated thereby. The GRIN fiber microlens shows less alignment sensitivity than ordinary fiber lens or aspherical fiber lens when used in a multiple emitters laser diode assembly. The GRIN lens further has the advantage of collimating a laser diode bar or array with a high degree of quality while minimizing phase aberration and distortion in the collimated transmitted beam.

U.S. Patent No. 5,786,582 to Roustaei et al. discloses an optical device for reading one- and two-dimensional symbologies at variable depths of field, the device including a light source for projecting an emitted light beam towards the two-dimensional image and an optical assembly, or zoom lens, with dual field of view capability for focusing light reflected from the framed symbology onto a CCD detector for detecting the focused light and generating a signal therefrom. The dual field of view capability enables scanning of both wide and narrow fields of view. An apodizing filter is provided within the optical assembly to increase depth of field. Aiming of the sensor to read the symbology is facilitated by a frame locator including a laser diode which emits a beam that is modified by optics, including diffractive optics, to divide the beam into beamlets having a spacing therebetween that expands to match the dimensions of the field of view of the sensor, forming points of light at the target to define the edges of the field of view. One or two sets of diffractive optics may be provided, with one set corresponding to each position, for each of

the dual field of view positions of the zoom lens.

U.S. Patent No. 5,717,221 to Li et al. discloses an electro-optical scanning device which reads indicia having parts of different light reflectivity, including bar codes and matrix arrays such as UPSCODES. The scanning device includes laser or light emitting diodes for emitting at least two light beams of the same or different wavelengths. The light beams may be visible to the human eye, and the beams are optically directed to form one or two scan lines to scan portions of a symbol. Dual photosensor(s) or a charge coupled device detects light reflected from the different portions of the symbol. The charge coupled device can be used to detect either reflected ambient light or the reflected visible light from the beams emitted by the diodes. The photosensors generate signals corresponding to the detected light which can be processed simultaneously. The device is particularly useful in reading two dimensional or more complex symbols. Methods for reading indicia are also described.

U.S. Letters Patent No. 5,710,417 to Joseph et al. discloses hand-held linear images, in which a plurality of the areas of differing light reflectivity of a bar code symbol or the like which are simultaneously illuminated using, for example, a beam of light that has an elongated cross-section. The light beam is swept over the symbol to be read in a direction transverse to the elongated dimension of the illuminated region so that a two-dimensional area of the symbol is illuminated over time. The reflected light is sensed by a 1D CCD array. A microprocessor within the scanner provides visual feedback to aid a user in aligning the device, and also provides for a selectable aspect ratio for the image, a selectable image resolution and size, a selectable aspect ratio of the illumination, and a selectable pixel size. All of these options may be programmed within the microprocessor, enabling the device to read a large variety of two-dimensional symbols.

U.S. Patent No. 5,672,858 to Li et al. discloses a scanning device for reading indicia of differing light reflectivity, including bar code or matrix array symbols, which has a single light emitter, such as a laser or light emitting diode, for generating a scanning light beam to visually illuminate sequential portions of the indicia. A sensor, such as a charge coupled device (CCD) or other solid state imaging device, simultaneously detects light reflected from portions of the indicia and generates an electrical signal representative of the spatial intensity variations of the portions of the indicia. The scanning device may also include an ambient light sensor, and a second light emitter for use only in aiming or orienting the scanning device. A photodetector may also be provided to separately detect one symbol virtually simultaneous with the detection of another symbol by the sensor or to provide dual modalities. A method for reading indicia is also provided.

U.S. Patent No. 5,649,070 to Connell et al. discloses a system for maintaining one or more sets of prototype descriptions for a number of classes of objects stored on a computer database. These prototypes are used as a basis for identifying the class of a presented object. A trainer determines when a new prototype is required to be added to the database based on current match results. This allows the system to be trained to recognize items in classes that deviate significantly from the items that were initially used to determine the classification rules. A determination is made about which prototypes can be deleted on the basis of their match histories. This allows the system to automatically optimize itself to work with a bounded collection of prototypes. In addition, it allows the system to track variations in class characteristics over time and adjust the corresponding set of prototypes appropriately.

U.S. Patent No. 5,621,203 to Swartz et al. discloses a plurality of the areas of different

light reflectivity of a bar code symbol, or the like, which are simultaneously illuminated using, e.g., a beam of laser light that has an elongated cross-section. The laser light beam is swept over the symbol in a direction transverse to the elongated dimension of the illuminated region so that a two-dimensional area of the symbol is illuminated over time, until the symbol is read. The light that reflects from the illuminated region of the symbol is imaged on a linear sensor array, which is then scanned or read out to produce signals representative of spatial intensity variations of the imaged light along a linear path in the field of view.

U.S. Patent No. 5,615,003 to Hermary et al. discloses a system for determining the shape and dimensions of a surface of an object which includes a projector for projecting onto the object a spatially coded pattern radiation, e.g., light. The system also includes a receiving device capable of imaging the reflected pattern, and a discriminator for determining which portions of the reflected pattern corresponds to which portion of the projected pattern. By this means, a received signal representing less than the complete reflection from the projected pattern can be correlated with a discrete portion of the scanned object. The procedure is repeated to obtain enough reliable data to generate a reasonably reliable surface profile. The resulting set of received signals and correlations are used to calculate the shape and dimensions of the object.

U.S. Patent No. 5,546,475 to Bolle et al. discloses a system and apparatus which uses image processing to recognize objects within a scene. The system includes an illumination source for illuminating the scene. By controlling the illumination source, an image processing system can take a first digitize image of the scene with the object illuminated a higher level and a second digitized image with the object illuminated at a lower level. Using an algorithm, the object(s) image is segmented from a background image of the scene by a comparison of the two digitized images taken. A processed image (that can be used to characterize features) of the object(s) is then compared to stored reference images. The object is recognized when a match occurs. The system can recognize objects independent of size and number and can be trained to recognize object that it was not originally programmed to recognize.

U.S. Patent No. 5,545,886 to Metlitsky et al. discloses a bar code scanner which employs an electronic means for causing the light beam to scan a bar code symbol, rather than using a mechanical device to generate the scan. A linear array of light sources, activated one at a time in a regular sequence, may be imaged upon the bar code symbol to simulate a scanned beam. Instead of a single linear array of light sources, a multiple-line array may be employed, producing multiple scan lines. The multiple scan lines may be activated in sequence, or activated simultaneously (time-division or frequency-division multiplexed). The multiple scan lines can provide signal enhancement, noise reduction or fault correction if directed to the same bar code pattern. Multiple scan lines may be generated using a single light source and a beam splitter, with mechanical scanning, as well as by the sequentially-activated light sources. Multiple simultaneous scan lines may be employed to generate a raster scan at lower mechanical scan frequency. In another embodiment, a tunable laser may be employed to provide a scan without moving parts; a laser beam from the tunable laser is reflected from a diffraction grating that produces an angular deviation dependent upon the wavelength of the laser output. As the frequency of the tunable laser is varied in some selected pattern, the laser beam will scan accordingly.

U.S. Patent No. 5,532,467 to Roustaei discloses an optical scanning head which includes at least one trio of light emitting diodes arranged so the LEDs emit light at different angles to create a fan of light. An optical module includes a light shield or "dark room" and a lens/filter assembly

which provides control of the depth of focus of the scanner. The optical module is located behind the light source, and the detector, made up of a CCD array is mounted behind the optic module for detecting the light intensity in the reflected beam over a field of view across a bar code symbol. The CCD array generates an electrical signal indicative of the detected light intensity. A DC source or battery provides DC voltage to the LEDs and CCDs in response to a clocked signal which provides a gradual or sequential illumination of the LEDs and coordinates the activation of the CCDs in order to minimize power consumption during scans.

U.S. Patent No. 5,378,883 to Batterman et al. discloses a hand-held bar code reader with a two dimensional image sensor for omnidirectional bar code reading, which includes variable imaging optics, and flash illumination with variable flash illumination optics. A spotter beam is provided for aiming the hand held bar code reader at a bar code symbol. The spotter beam is also used to measure the range to said bar code from said hand held bar code reader and to determine the focal length of said variable imaging optics and variable flash illumination optics. The imaging optics are adjusted automatically to provide the correct magnification and focus of a bar code regardless of range to the label. The variable focal length flash illumination optics are used to concentrate illumination energy only in the field of view of the bar code reader. The flash illumination energy is conserved by measuring the ambient light and setting the level of flash illumination energy in accordance with the measured level of ambient light. In such a manner, conventional, damaged, multiple, and stacked bar code symbols along with true two dimensional codes may be rapidly read over distances from under one foot to over several feet without having to align the bar code reader to the bar code.

U.S. Patent No. 5,319,185 to Obata discloses a bar code reader which has a sensor unit to be mounted on an operator's finger and a decoder unit to be mounted on an operator's wrist, the sensor and decoder units being electrically connected by a cable. The sensor unit has a light-emitting device for emitting light toward a bar code to be read, a graded-index rod lens array for focusing an entire linear optical image of the bar code at one time in substantially the same size as the bar code, and a line image sensor such as a CCD for photoelectrically converting the entire linear optical image focused by the optical means into an electric signal. The decoder unit decodes the electric signal from the line image sensor. The light-emitting device, the rod lens array, and the line image sensor are housed in a hollow casing. A movable tubular member is movably disposed in the hollow casing and has an end wall for abutment against the bar code. A switch for energizing the light-emitting device and the decoder unit is fixedly mounted in the hollow casing and triggerable by the movable tubular member when the movable tubular member is moved by abutment of the end wall thereof against the bar code.

U.S. Patent No. 5,319,181 to Shellhammer et al. discloses a method and apparatus for decoding a two-dimensional bar code symbol using a charge-coupled device (CCD) camera or a charge-modulation device (CMD) camera. The CCD/CMD camera takes pictures of the symbol and the picture is converted into digital data. The location and orientation of the two-dimensional bar code symbol is determined and verified. Defects and damages on the symbol are detected and corrected. The symbol is scanned to read the codewords of the two-dimensional bar code symbol.

U.S. Patent No. 5,291,009 to Roustaei discloses an ornamental design for a bar code scanner which uses the Light Emitting Diode (LED), Optical Scanner assembly and Charge-Coupled Devices (CCD) capable of reading the barcode symbols at the variable distance. The optical passive elements for increasing the depth of field and method of fabricating the scanning

head by mass-production techniques are also disclosed.

U.S. Patent No. 5,258,605 to Metlitsky et al. discloses a bar code scanner which employs an electronic means for causing the light beam to scan a bar code symbol, rather than using a mechanical device to generate the scan. A linear array of light sources, activated one at a time in a regular sequence, may be imaged upon the bar code symbol to simulate a scanned beam. Instead of a single linear array of light sources, a multiple-line array may be employed, producing multiple scan lines. The multiple scan lines can provide signal enhancement, noise reduction or fault correction if directed to the same bar code pattern. Multiple scan lines may be generated using a single light source and a beam splitter, with mechanical scanning as well as by the sequentially-activated light sources. Multiple simultaneous scan lines may be employed to generate a raster scan at lower mechanical scan frequency. In another embodiment, a tunable laser may be employed to provide a scan without moving parts; a laser beam from the tunable laser is reflected from a diffraction grating that produces an angular deviation dependent upon the wavelength of the laser output. As the frequency of the tunable laser is varied in some selected pattern, the laser beam will scan accordingly.

U.S. Patent No. 5,212,390 to LeBeau et al. discloses a device which employs a laser diode and cylindrical lens to project a plane of laser at an incidence angle onto a plurality of leads. The light is simultaneously reflected from each of the plurality of leads. The light that is simultaneously reflected from each lead is detected by an image sensor. A digital computer computes the cotangent function of the incidence angle to detect an amount of displacement of at least one of the plurality of leads.

U.S. Patent No. 5,192,856 to Schaham discloses in Fig. 1 a hand-held imaging device for reading and interpreting bar codes which illuminates the bar code with a fixed elliptical light beam (produced by an LED and collimating and cylindrical lens), and images the reflected beam onto a linear CCD array which is aligned with the light beam. The black and white bar information is detected by the electronically scanned elements of a linear CCD array. The limited operational range, determined by the optical system depth of focus, is enhanced significantly to a useful operational range by automatically focusing the image of the bar code on the CCD array.

U.S. Patent No. 5,136,145 to Karney discloses a symbol reader that uses a dynamic random access memory as a detector element and a gradient refractive index material as the lens to capture a symbol image. The rod shaped lens passes through an opaque cover and confronts the array of memory elements in the memory. The cover is glued to a memory device package. The PN junctions of the random access memory are activated by light reflected from a symbol and appear as data when the random access memory is read out. The light can be provided by light emitting diodes positioned adjacent to the memory package and in a handheld wand that includes a light reflecting shield in which the symbol is positioned for reading. The wand is positioned over the symbol and a read button is depressed. A computer monitoring the read button activates the light emitting diodes and then reads out the contents of the random access memory, unscrambles the data, signals the user that the symbol has been captured and then outputs the symbol image.

U.S. Patent No. 4,979,815 to Tsikos discloses a range imaging system, and a method for calibrating such a system which are based on the principles of projective geometry. The system comprises four subsystems: (1) a laser and a cylindrical lens or vibrating mirror for producing a planar beam of light; (2) an electronic camera equipped with a lens and an appropriate interference

filter; (3) an electronic circuit for height (depth) measurements and video image generation; and (4) a scanning mechanism for moving the object with respect to the light beam and the camera so as to scan an area of the object surface. The system is calibrated by determining the position in the electronic image of the object surface at three different heights. The range image is generated from these three known heights from either a previously determined look-up table, or from a calculation based on the invariance of the cross-ratio, a well known ratio from projective geometry.

U.S. Patent No. 4,900,907 to Matusima et al. discloses a handheld reader for reading optical information such as a bar code contains a reading sensor. An image of the optical information is imaged by light produced by a pair of LEDs and reflected from the optical information, via a reflecting mirror, a lens and a diaphram member, onto the reading sensor so that the image is converted into an electric signal. The pair of LEDs are disposed on both sides of the image sensor so that the images thereof are imaged near the optical information by light from the LEDs through the diaphram member, the lens and the reflecting mirror. The LEDs and reading sensor are controlled so that the LEDs are disabled from emitting light while the reading sensor performs the reading operation of the optical information.

U.S. Patent No. 4,826,299 to Powell discloses a lens which has the appearance of a prism with a relatively sharp radius at the apex. This lens finds an application in expanding a laser beam in one direction only.

U.S. Patent No. 4,743,773 to Katana et al discloses a bar code scanner applicable for use to scan various bar codes of different standards and sizes. Any malfunction due to non-uniform illumination of the bar code or maloperation can be prevented, and also the light source may not be normally turned on. This bar code scanner is usable as held by hand or fixed as desired. The opening of the scan head of the inventive bar code scanner is formed polygonal, and high light-transmission diffusion filter is provided between the light source and the opening. The light source consists of spot light sources disposed in plural linear arrays including the ones which are normally on for sensing the proximity to a bar code and the others which are turned on and off depending on whether the scan head is near or far from a bar code. Furthermore, the scan head enclosure consists of a gripping portion for the operation of the scanner as held by hand and a flat bottom portion for use in operating the scanner as fixed; both portions are integrally formed to be the enclosure in which a light source, photodetector, decoder and interface subside.

U.S. Patent No. 4,741,621 to Taft et al. discloses a surface inspection system with a single light source producing two light stripe sheets projected from different angles onto an inspected surface so that a combined light sheet produces a light stripe image with no shadow results. The two light stripe sheets are created by tangentially reflecting a laser beam off of separate cylindrical reflectors. The light stripe is detected by an imaging system, including a camera having a CCD image array, held at a fixed angle with respect to the light sheet which allows the two-dimensional curvature of the stripe to be detected. The two-dimensional light stripe image is converted into a digital image and processed by linear and logical digital filters that narrow the stripe down to two pixels wide. A coordinate extraction apparatus extracts the coordinates of the bottom row of the pixel image producing a digital representation of the light stripe curve. The sample curve is compared by a computer with a reference curve by obtaining the absolute value of the difference in height of points along the sample and reference curves after alignment and comparing the absolute value to an error or tolerance threshold. Any deviation beyond the fixed tolerance is

reported as a surface irregularity defect.

U.S. Patent No. 4,687,325 to Corby, Jr. discloses a three-dimensional range camera system which measures distance from a reference plane to many remote points on the surface of an object. The set of points at which range is measured lie along a straight line (N points) or are distributed over a rectangular plane (MxN points). The system is comprised of a pattern generator to produce a 1xN array of time/space coded light rays, optionally a means such as a rotating mirror to sweep the coded light rays orthogonally by steps, a linear array camera to image subsets of the light rays incident on the object surface, and a high speed range processor to determine depth by analyzing one-dimensional scan signals. The range camera output is a one-dimensional profile or a two-dimensional area range map, typically for inspection and robotic vision applications.

WIPO Publication No. WO 01/71419 A2 by Accu-sort Systems, Inc., discloses a scanning system which utilizes a randomly addressable image sensor which is selectively positioned at the Scheimpflug angle in the image plane in order to detect focused light reflected from an object. Light reflected from the object is focused onto the sensor through an objective lens. Since the sensor is mounted at the Scheimpflug angle, each strip within the depth of field of the object plane has corresponding pixels on the sensors which are in focus.

WIPO Publication No. WO 01/2028 A1 by Accu-sort Systems, Inc., discloses a system for scanning objects having a linear array sensor, adapted to detect light input signals. A lens is optically connected to the linear array sensor, and is adapted to receive and transmit an optical image located in a field of view along a lens axis to the linear array sensor. A light source which generates an illumination stripe in general linear alignment with the lens axis is provided. A cylindrical lens is positioned between the light source and an object to be scanned. The cylindrical lens adapted to collect, transmit and focus light from the light source to form the illumination stripe.

U.S. Provisional Application No. 60/190,273 by Chaleff et al. publishes as WIPO International Publication No. WO 01/72028 A1, discloses an optical scanning system containing a coplanar camera utilizing a LED array light source and a linear CCD sensor array.

WIPO Publication No. WO 99/64980 by Symbol Technologies, Inc. discloses an imaging engine and signal processing devices and methods for reading various kinds of optical codes. The compact structure (54") may include a two-dimensional image sensor, apparatus for focusing images at different focal disclosures, a laser-beam type aiming system, a hi-low beam illumination system employing an array of LEDs on lenslet plate (50), and related signal processing circuits.

WIPO Publication No. WO 99/21252 by Honeywell, Inc. describes a Vertical-Cavity surface Emitting Laser (VCSEL) for producing a filamented light output. In a preferred embodiment, this is accomplished by providing a number of discrete objects that are positioned adjacent to or within one or both of the cladding mirrors, or within the active region itself. The discrete objects may alter the reflectance, current injection and/or gain of the VCSEL at corresponding discrete locations, thereby causing the filamented light output. Besides providing a filamented output, the VCSEL operates at a low drive current, provides high performance, and occupies less physical area than a broad-area (wide aperture) VCSEL. Thus, the VCSEL has a number of advantages provided by a conventional laser including speed, efficiency and power, but does not suffer from many of the disadvantages of high coherence. The utilization of speckle

averaging within multi-mode fiber interconnections and CD-like spatial imaging applications are contemplated.

The web-based publication for the "AV3700 Coplanar Illumination Option" by Accu-Sort Systems, Inc. describes coplanar lighting technology that concentrates critical light on the target surface in the linear read area. This concentrated illumination feature allows high-speed, high-resolution image capture using a low-power LED light source. Coplanar LED illumination eliminates the mounting angle between the line of sight of the camera and the light source. This maximizes the return light and allows for a lower intensity light source.

The Intevac Product Brochure for the Model 120 LIVAR Short Wave IR Gated Camera describes a range-gated, laser-illuminated, two-dimensional imaging system that operates in the "eye-safe" wavelength band.

The web-based publication for the Intevac New LIVAR Imagery system (http:www.intevac.com/livar_imagery/livar_imagery.html) exhibits the Laser Illuminated Viewing and Ranging (LIVAR) system which is designed for range-gated imaging in the 1.5um band.

The scientific publication entitled "High-Speed, Repetitively Pulsed Ruby Laser Light Source" by Physical Sciences Inc. describes the development of a high-repetition rate, multi-pulsed ruby laser as a light source for high-speed events. This red light laser incorporates repetitive Q-switching technology to achieve high individual pulse energies sufficient to overcome the self-luminosity of a supersonic bow shock.

The website for INO, Inc.'s "Collimated Laser Diode Arrays" describes laser diode arrays which are collimated using microlens collimation technology. Microlens collimation increases the laser diode array brightness by more than two orders of magnitude. Beam divergence depends on laser array size and is typically 2.0* x1.0* FWHM for large, high-density multi-bar arrays but can be nearly diffraction-limited for single-bar arrays. The highly diverging "fast" axis is collimated using a proprietary GRIN cylindrical microlens array and the "slow" axis is collimated using a plano-convex cylidndrical mocrolens array. These microlens arrays are permanently attached to the laser array assembly and are mechanically robust and insensitive to vibration and temperature variations.

The StockerYale Product Brochure for the Lasiris™ SNF Laser describes Lasiris™ SNF beam shaping optics which transforms the familiar laser dot into different shapes and sizes. For example, a straight line can be projected by allowing one dimension of light to fan out while maintaining tight control over the other, resulting in a sheet-of light. This laser system incorporates an optical line generator that eliminates gaussian distribution of the light.

The DALSA, Inc. Product Brochure for the DALSA IT-P4 Image Sensors describe the Dalsa IT-P4 sensor as having feature 4096, 6144, or 8192 elements and using proprietary technology to provide four outputs at 40MHz each. The DALSA IT-P4 Image Sensor employs buried channel CCD shift registers to maximize output speed and reduce noise. The IT-P4 sensor has a dynamic range of >1600:1 and a linear dependence on light level up to saturation. The exposure control of the IT-P4 sensor allows integration times shorter than the readout time.

The Eastman Kodak Company Product Brochure for the KAF-4202 Series Full-Frame

CCD Image Sensor describes a high performance monochrome area CCD image sensor with 2032 H x 2044V photo active pixels designed for a wide range of image sensing applications in the 0.4 nm to 1.0 nm wavelength band. Typical applications include military, scientific, and industrial imaging. A 74dB dynamic range is possible operating at room temperature.

The Camera User's Manual for the DALSA Piranha CT-P4, CL-P4 High-Speed Line-Scan Camera describes a modular camera which uses the reliability, flexibility, and cost-effectiveness of high-volume interchangeable parts. Within the Piranha camera, a timing board (PB-P1-X206) generates all internal timing and a driver board (PB-P1-X139) provides bias voltages and clocks to the CCD image sensor. For enhanced dynamic range, one or two A/D board (PB-xx-D344) process the video and digitize it to 10 bits before outputting the most significant 8 bits.

The Sony Product Brochure for the ICX085AL Progressive Scan CCD Image Sensor Chip describes a 2/3-inch interline CCD solid-state image sensor with a square pixel array. Progressive scan allows all pixel signals to be output independently within approximately 1/12 second. This sensor chip features an electronic shutter with variable charge-storage time which makes it possible to realize full-frame still image without a mechanical shutter. High sensitivity and low dark current are achieved through the adoption of HAD (Hole-Accumulation Diode) sensors.

The Mitsubishi Product Brochure for the ML1XX6 series laser diodes describes a high power AlGalnP semiconductor laser which provides a stable, single transverse mode oscillation with emission wavelength of 658-nm and standard CW light output of 30mW.

The article entitled "Laser triangulation: fundamental uncertainty in distance measurement" by Dorsch et al. discusses the uncertainty limit in distance sensing by laser triangulation. The uncertainty in distance measurement of laser triangulation sensors and other coherent sensors is limited by speckle noise. Speckle arises because of the coherent illumination in combination with rough surfaces. A minimum limit on the distance uncertainty is derived through speckle statistics. This uncertainty is a function of wavelength, observation aperture, and speckle contrast in the spot image. Surprisingly, it is the same distance uncertainty obtained from a single-photon experiment and from Heisenberg's uncertainty principle. An uncertainty principle connecting lateral resolution and distance uncertainty is introduced. Design criteria for a sensor with minimum distance uncertainty are determined: small temporal coherence, small spatial coherence, a large observation aperture.

The scientific publication entitled "The Use of Diode Laser Collimators for Targeting 3-D Objects" by Clarke et al. describes the theory of speckle, the magnitude of the location error due to speckle, and methods which can minimize or remove the effect of speckle.

The Web-based IBM research publication entitled "Green Machine" by Bruce Schechter describes a computer vision system, dubbed Veggie Vision, that is capable of distinguishing between the 150 or so different fruits and vegetables found in the produce section of any supermarket. The produce is placed on a glass surface of a scale built into the checkout counter. A CCD camera looks upward through the glass at the produce, which is illuminated from below by a ring-shaped fluorescent tube. Two images of the produce are captured, one with the light on and the other with the light off. Once the image of the produce is captured, its color is analyzed into hue, saturation and intensity, yielding a color signature. Shape, texture and size information derived from the images provides the final clues.

The Web-based research publication of the Projects and Research Topics of Gabriel Taubin of IBM Research offers a synopsis of Taubin's research subject matter for projects including Geometry Compression and Progressive Transmission, VRML Compressed Binary Format, MPEG-4 3D Mesh Coding, 3D Scanning Michelangelo's Florentine Pieta, Signal Processing on Polygonal Meshes, Curvature Estimation, Rasterization of Algebraic Curves and Surfaces, 3D Transition Effects for PVS Non-Linear Video Editor, Face Reconstruction From 2 Images, Produce Recoginition System, Veggie Vision, Algebraic and Moment Invariants, Algebraic Curve and Surface Fitting, and Cathegory Theory.

A separate listing of the above references on PTO Form 1449 and a compact disc containing copies of these references in .pdf format are enclosed herewith for the convenience of the Examiner.

The Commissioner is also hereby authorized to charge any fee deficiencies to Deposit Account No. 16-1340.

Respectfully submitted,

Dated: October 25, 2002

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Thomas J. Perkowski

Thomas J. Perkowski, Esq.
Dated: October 25, 2002

Substitute for form 1449A/PTO

INFORMATION DISCLOSURE STATEMENT BY APPLICANTS

Sheet	1	of	7

Complete If Known	
Application Number	10/068,803
Filing Date	February 6, 2002
First Name Inventor	Tsikos et al.
Group Art Unit	2876
Examiner Name	n/a
Attorney Docket Number	108-127USAND0

U.S. PATENT DOCUMENTS

Examiner Initials	Cite No.	U.S. Patent Documents		Name of Patentee or Applicant of Cited Document	Date of Publication of Cited Document MM-DD-YYYY	Intn'l Class / Sub Class
		Number	Kind Code (if known)			
		6,369,401		Lee et al.	04/09/2002	G01B 11/10
		6,310,964		Mohan et al.	10/30/2001	G06K 9/00
		6,223,988 B1		Batterman et al.	05/01/2001	G06K 7/10
		6,005,959		Mohan et al.	12/21/1999	G06K 9/00
		Re: 36,528		Roustaei	01/25/2000	G06K 7/10
		5,988,506		Schabam et al.	11/23/1999	G06K 07/10
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		5,828,050		Barkan	10/27/1998	G06K 7/10
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Examiner Initials	Cite No.	U.S. Patent Documents		Name of Patentee or Applicant of Cited Document	Date of Publication of Cited Document MM-DD-YYYY	Intn'l Class / Sub Class
		Number	Kind Code (if known)			
		5,786,582		Roustaei et al.	07/28/1998	G02B 26/08
		5,717,221		Li et al.	02/10/1998	G06K 7/10
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		5,649,070		Connell et al.	07/15/1997	G06F 17/00
		5,621,203		Swartz at al.	05/15/1997	G06K 7.10
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Examiner Initials	Cite No.	U.S. Patent Documents		Name of Patentee or Applicant of Cited Document	Date of Publication of Cited Document MM-DD-YYYY	Intn'l Class / Sub Class
		Number	Kind Code (if known)			
		5,258,605		Metlitsky et al.	11/02/1993	G06K 7/14
		5,212,390		LeBeau et al.	05/18/1993	G01V 9/04
		5,192,856		Schaham	03/09/1993	G06K 7/10
		5,136,145		Karney	08/04/1992	G06K 13/00
		4,979,815		Tsikos	12/25/1990	G01C 3/00
		4,900,907		Matusima et al.	02/13/1990	
		4,826,299		Powell	05/02/1989	G02B 13/18
		4,743,773		Katana et al.	05/10/1998	G06K 7/10
		4,741,621		Taft et al.	05/03/1988	G01B 11/24
		4,687,325		Corby	08/18/1987	G01C 3/00

PUBLICATIONS		
Examiner Initials	Cite No.	Description
		Web-based publication entitled "AV3700 Coplanar Illumination Option" by Accu-Sort Systems, Inc., www.accusort.com/products/coplanar.html, 1 page.
		Web-based Product Brochure on Model 120 LIVAAR Short Wave IR Gated Camera Specification, by Intevac Corporation, Santa Clara CA, September 2001, pages 1-2.
		Web-based presentation entitled "NEW LIVAR IMAGERY" by Intevac Corporation, Santa Clara CA, http://www.intevac.com/livar_imagery/livar_imagery.html. 2001, pages 1-9.
		Web-based brochure for Intevac Photonics Division Products- Laser Illuminated Viewing and Ranging (LIVAR) System, Intevac, Inc., http://www.intevac.com/photonics/products.html, 2001, pages 1-5.
		Web-based brochure entitled "High-Speed, Repetitively Pulsed Ruby Laser Light Source" by Physical Sciences Inc., http://www.psicvorp.com/html/prod/lasillum.htm, 2001, pages 1-4.
		Web-based brochure entitled "Collimated Laser Diode Arrays" by INO, Inc., http://www.ino.qe.ca/en/syst_et_compo/clda.asp, 2001, pages 1-2.
		Product Brochure for the Lasiris™ SNF Laser by StockerYale, Salem NH, 2001, pages 1-4.
		Product brochure for DALSA IT-PA Image Sensors, by Dalsa, Inc., 2001pages 1-14.
		Product Specification for "KAF-4202 SERIES Full-Frame CCD Image Sensor Performance Specification" by Eastman Kodak Company, Rochester NY, June 29, 2000, pages 1-15.
		User Manual for the Piranha CT-P4, CL-P4 High Speed Line Scan Camera by Dalsa, Inc., 2000, pages 1-30.
		Product brochure for Sony ICX085AL 2/3-inch Progressive Scan CCD Image Sensor with Square Pixel for B/W Cameras, by Sony Corporation, 2000, pages 1-20.
		Product brochure for "ML1XX6 Series for Optical Information Systems" by Mitsubishi Electric, December 1999, pages 1-4.
		Web-based publication entitled "3-D Sensing" by Papadoupoulos, http://perso.club-internet.fr/dpo/numeerisation 3d, 1995, pages 1-12.

PUBLICATIONS		
Examiner Initials	Cite No.	Description
		Scientific publication entitled "Laser triangulation: fundamental uncertainty in distance measurement" by Dorsch et al., Applied Optics, Vol. 33(7), March 1994, pages 442-450.
		Scientific publication entitled "The Use of Diode Laser Collimators for Targeting 3-D Objects" by Clarke et al., Dept. Engineering/City Univ./London, 1994, pages 47-54.
		Web-based research publication entitled "Green Machine" by Bruce Schechter, IBM Research, http://www.research.obm.com/resources/magazine/1999/number_3/machine399.html, 1999, pages 1-4.
		Web-based research publication of Projects and Research Topics by Gabriel Taubin, IBM T.J. Watson Research Center, http://www.research.ibm.com/people/t/taubin/research.html#computer-vision-apps, 1978-1999, pages 1-19.

FOREIGN PATENT DOCUMENTS

Examiner Initials		Foreign Patent Document			Name of Patentee or Applicant of Cited Document	Date of Publication of Cited Document MM-DD-YYYY	Intn'l Class / Sub Class	T *
		Office	Number	Kind Code (if known)				
		PCT	WO 01/71419 A2		Accu-Sort Systems, Inc.; Telford, PA	09/27/2001	G03B	
		PCT	WO 01/72028 A1		Accu-Sort Systems, Inc.; Telford PA	09/27/2001	H04N 1/028	
		US	60/190,273		Thomas J. Brobst	05/29/2001		
		US	WO 99/64980		Symbol Technologies, Holtsville NY	12/16/1999	G06K 7/10	
		PCT	WO 99/21252		Honeywell, Inc.; Minneapolis MN	04/29/1999	H01S 3/085	

PUBLICATIONS		
Examiner Initials	Cite No.	Description
		2002 Search Report for International Application No. PCT/US01/44011

EXAMINER **DATE CONSIDERED**

EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609; Draw line through citation if not in conformance not considered. Include copy of this form with next communication to applicant.

(INFORMATION DISCLOSURE STATEMENT – SECTION 9 PTO-1449)